1857MNRAS..17..182M

Reading corresponding to positive contact of ⊙'s limb $= \omega = +30'\ 16''$, $\omega' = 0^{\circ}\ 46$

— — negative — — $= \omega' = -34\ \ 8$, $(\omega') = 5\ \ 12$

Quantity opposite (ω) in the table $= -25''.7$ $\qquad \omega + \omega' = -\ 3\ \ 52$

— — (ω') — -28.6 $\qquad$ Half $= -\ 1\ \ 56$

-54.3 … … $-\ \ 27.2$

$\varepsilon = -\ 2\ \ 23.2$

and this new value of ε must now be applied to all angles alike, the second correction being taken from the table as before.

When the sun is observed for the purpose of determining the values of the constants, the image should be darkened by a shade placed before the eye-piece of the telescope.

The value of ε will in most cases be more or less affected by the interposition of shades before the index-glass, or behind the horizon-glass. The corrections due to each particular shade should therefore be determined, in order that in the event of our employing them for the purpose of darkening the image of the sun or moon in the course of ordinary observation, we may be prepared to apply the proper constant in the correction of the angle. This is done by observing, first, the contact of the images of the sun's limb with a shade before the eye-piece of the telescope only. The same contact being then observed with as many different combinations of the other shades as their number amounts to, we shall be furnished with as many simple equations, from which the several corrections may be determined.

A traveller on land treating the sextant in the manner above described ought very readily to obtain his latitude to the nearest second of arc: and if the results of his lunar distances be subsequently corrected for the errors in the tabular elements of the moon's place, his longitudes will probably be in most instances much within ten seconds of time from the truth. And as regards lunar observations at sea, the results must of course be materially affected by the correction of the observed angles to an extent exceeding in general the amount of probable error arising, even under unfavourable circumstances, from the difficulties attending the operation, and from deficiency of power in the instrument.

On the Value of the Constant of Refraction, as determined from Zenith-Distance Observations of Stars near the North and South Horizon, made at the Royal Observatory, Greenwich, in the years from 1836 *to* 1854. By the Rev. Robert Main, M.A.

The object of this paper is stated by the author to be the determination of the degree of accuracy with which Bessel's Refraction Tables, given in the *Tabulæ Regiomontanæ*, represent the star-observations made at Greenwich. Those tables, as is well known,

1857MNRAS..17..182M

are mainly derived from the *Fundamenta*, the only change of importance being the increase of the mean refractions as far as 85° zenith distance in the proportion of 1 : 1·003282, and in the substitution of values for the mean refractions of stars below that limit, empirically derived from observation.

This break of continuity in the tables rendered it necessary to reduce all the errors ultimately to errors of the tables given in the *Fundamenta*, and to deduce the correction which it would be necessary to apply to the mean refractions given in that work.

The author enters into a discussion of the method which it would be necessary to adopt in the investigation, if the errors were ultimately found to be of sufficient magnitude to affect sensibly the places of the stars by which the latitude of the Observatory has been determined, which is fortunately proved not to be the case in the use of the refractions of the *Tabulæ*.

With regard to the materials for the investigation, it was first necessary to extract from the Greenwich Twelve Year-Catalogue, and the subsequent Star Catalogues, all the southern stars whose meridian-zenith distances at Greenwich are greater than 70°, and all the circumpolars of greater than 70° zenith-distance at their transit beneath the pole.

In the treatment of the north stars, the mean north polar distances derived from the individual observations are compared with those given in the Greenwich Catalogues reduced to the proper epoch by the annual variations given in the British Association Catalogue, the stars passing the meridian so near the zenith at the upper transit as to make the deduced places given in the Greenwich Catalogue independent of moderate errors in the refraction-tables.

With regard to the southern stars, only such were available as could be compared by means of observations made at some southern observatory near whose zenith they pass the meridian. One list of stars affording such comparison is that given in a paper by the late Professor Henderson, and printed in Vol. X. of the *Memoirs* of this Society. Only fourteen stars, however, were furnished by this catalogue which could be compared with the Greenwich Observations. Other stars for comparison were furnished from Mr. Maclear's observations of zenith-distance made with Bradley's sector at the Cape Observatory, in connexion with the triangulation. These zenith-distances, when reduced to mean north polar distances by the application of Henderson's colatitude, furnished thirty-three additional stars available for the investigation.

The author then points out the circumstances in Bessel's refraction-theory, which rendered it necessary to arrange in order of temperature the individual errors of refraction for all such stars as were observed with sufficient frequency and under different atmospheric circumstances, to discover whether any law of error were observable dependent upon temperature. The arrangement shows pretty clearly that there is no sensible error due to this element.

1857MNRAS..17..184C

The remaining tables in the memoir are designed to show the errors of mean refraction of the *Tabulæ*, and the arrangement is therefore according to the order of the zenith-distances of the stars. All the errors of mean refraction of the *Tabulæ* are reduced to errors of the *Fundamenta* by comparison of the errors of the two sets of tables, and the errors of the *Fundamenta* are then grouped for convenient intervals of zenith-distance, and the results derived from the three lists of stars are finally combined.

The conclusions derived from the whole investigation, with regard to errors of mean refraction, are the following :—

1. As far as 82° zenith-distance the mean refractions of the *Tabulæ* are very nearly correct, and no corrections could be safely applied.

2. From 82° to 85° zenith-distance the logarithms of the refractions of the *Tabulæ* require diminishing by 0·00100.

3. From 85° to the horizon it seems expedient to give up the use of the mean refractions in Bessel's Supplementary Tables given in the *Tabulæ*, and to use those of the *Fundamenta*, diminishing the logarithm by 0·00066.

A projection of the star *Spica Virginis* on the moon's disk was witnessed on the 12th of March by C. R. Chalmers, Esq., at Barrie, Simcoe County, Canada West. His note of the occurrence runs thus: "The sky was cloudless, and I watched the star up to the bright edge. I then expected to lose sight of it, but it continued to advance on the face of the moon until I could distinctly see the limb *outside* the star. *Of this I am quite positive.* I counted several seconds from the first contact till the disappearance of the star, which was instantaneous. The star had a curious planetary appearance, which was also remarked by a friend at Toronto with a 4¼-inch refractor. The telescope I used is a 42-inch, by G. Dollond, of 2¼ inches aperture. Power 60." Mr. Chalmers adds that the superiority of the climate of Canada over that of England is very marked, a 3-inch aperture in Canada doing the work of a 4-inch in England.

Experiences with a Free-Revolver Stand for a Telescope at Sea, during a Voyage to Teneriffe in the Summer of 1856. By Professor C. Piazzi Smyth, F.R.S.E., Astronomer Royal for Scotland.

(*Continued from the December Number.*)

"The opportunity of making these experiments was afforded by the voyage that formed part of the astronomical expedition to Teneriffe last summer, and the vessel in which they were made